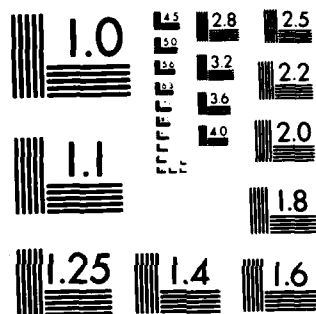


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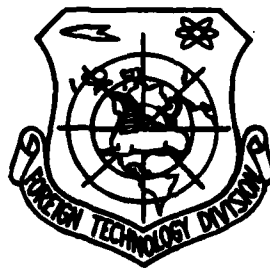
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LASER JOURNAL  
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## EDITED TRANSLATION

FTD-ID(RS)T-1751-82

16 February 1983

MICROFICHE NR: FTD-83-C-000199

LASER JOURNAL (Selected Articles)

English pages: 6

Source: Jiguang, Vol. 9, Nr. 5, 1982, pp. 26;  
96; 106; 107

Country of origin: China

Translated by: SCITRAN

F33657-81-D-0263

Requester: FTD/TQCS

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1. Discussion For

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#### GRAPHICS DISCLAIMER

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## A DOUBLE BEAM TUNABLE TEA CO<sub>2</sub> LASER

Zhou Yueliang, Chen Zhenghao, Cui Dafu, Lu Huibin\*

We have developed a double beam tunable TEA CO<sub>2</sub> laser. In addition to the characteristics of repeating operating frequency (the repetition rate is greater than 10 pulses/sec) and long lifetime (one filling can continuously work for 10<sup>6</sup> pulses), this equipment has the following special properties:

1. In the same gain medium, it is possible to have two laser beam oscillations simultaneously and synchronistically. Each beam is immediately turnable between 9.2 to 10.9 micrometers.

2. Each laser beam can operate in the single transverse output mode or in the multiple transverse output mode. The output power of each beam in the single line single transverse mode can reach 0.5 megawatt and the output power of the single line multiple transverse output mode can reach 1 megawatt.

The special features of the structure of the laser are:

The main discharge electrode ionization system and air circulation -- cooling system is placed inside an organic glass cylinder 300 mm in inner diameter and 1 meter long. The laser is equipped with a gas generator. It can use air as the gas source to carry out the work. Both ends of the organic glass cylinders are sealed with flanges. The total reflective mirrors of the double beam multiple reflection optical path and the mode adjusting device are installed on the flanges.

\* Institute of Physics, Academia Sinica

## PROGRESS OF SATELLITE LASER RANGING IN SHANGHAI OBSERVATORY

Satellite Laser Ranging Research Group

(Shanghai Observatory, Academia Sinica)

This paper comparatively introduced the overall objectives, progress and future plans of the satellite laser ranging work at Shanghai Observatory, Academia Sinica for the past nine years.

In the paper, a brief introduction of the performance of the first generation ruby laser ranging system was described. It introduced the satellite forecasting and the domestic laser ranging network, including the measuring organizations and the applied purpose of the information. A briefing of the experimental Nd = YAG laser ranging system and the situation with regard to the attendance of the international joint laser ranging in August - October 1980 were included. It also briefly introduced the second generation laser ranging system which was planned to be built in 1982.



PRECISE DETERMINATION OF TEMPORAL DIFFERENCE OF ATOMIC CLOCKS  
IN TWO SEPARATE PLACES WITH LASER PULSE TRANSFER TECHNIQUE

Laser Temporal Comparison Group  
(Shanghai Observatory, Academia Sinica)

The comparison of clocks in two separate places usually can use the microwave, television, LDRAN-C, and moving clock methods. The first three methods have lower accuracies which can only reach the 0.1 microsecond level. The accuracy of the moving clock is higher but it is more troublesome. In addition, it can not perform comparison frequently and over a long period of time.

Using laser pulse transfer technique to carry out comparison of clocks in two separate places is a new technique. We used the ruby dye tunable Q laser and two sets of photoelectric receiving systems to carry out comparison tests on the two rubidium clocks of Shanghai Observatory located at Xu Jra Hai and She Shan separated by 25.2 kilometers<sup>1</sup>. In a time period of 2-3 minutes, the accuracy of comparison can be within 10 nanoseconds. Simultaneous to laser comparison, a small imported cesium atomic clock was used to conduct the moving clock experiment. The results indicated that the results by both comparison methods agreed with each other.

This is the first time in this country to use this technique for temporal comparison experiment. The present result is preliminary. Some improvement in the near future was planned. It is predicted that the results will be further improved.

JITTERING AND SPREADING OF INFRARED LASER LIGHT  
IN NEAR-GROUND ATMOSPHERE

Song Zhengfang, Han Shouchun, Ding Quiang, Qi Fudi,  
Gu Weiyu, Liu Xiaochun

(Anhui Institute of Optics and Fine Mechanics, Academia Sinica)

In addition to the production of intensity and phase fluctuations when a finite beam is transmitted through turbulent atmosphere, there are jittering and spreading effects which may be deleterious to some laser engineering projects. In the past, frequently a photographic method or an one-dimensional optomechanical scanning method was used to conduct the measurement. The former could not be used for infrared light and it required a set of complicated post-treatment equipment. The latter could not be used for light pulses and its accuracy is low. The television photography technique can overcome the above shortcoming. However, the frequency bandwidth of the picture data is wide and the data quantity is huge. It is impossible to manually process any of the steps. Even the usual microcomputer cannot handle it. We adopted the variable speed scanning method to realize the automatic data acquisition and operation using a microcomputer. The entire plan is composed of a camera, video recorders, visual frequency memory, data collector, microcomputer, and pseudocolor monitor. First, the pictures are stored using normal television format. Then, they are slowly read out to the input of the microcomputer at one picture per second. Finally, calculations such as effective diameter and intensity center are carried out. After taking the statistical average of several pictures, we can obtain the jittering square deviation and the spread square deviation.

In August 1981, we collaborated with the seventh group of Dai Lian Chemical Physics Institute to conduct the experiment on light jittering and spreading in the city of Dai Lian. We used four lasers, viz He-Ne (0.6328 micron), YAGA (1.06 micron), HF (~2.9 micron), and OF (~3.8 micron). The transmission distance was 880 meters and the average height of the optical path above the ground was about 20 meters. The underlaying surface was very complicated. Over 70 sets of data were obtained. In addition, we also measured the glittering of the He-Ne laser, the temperature pulse, and the regular weather factors in order to carry out analysis and comparison.

Presently, part of the data has been processed using pseudocolor. The mean square root values of the YAG laser and He-Ne laser were 7.2 and 8.7 mm, respectively. These are very close to the theoretically estimated values. The correlation between the measured and theoretical values is also good. The turbulent spreading diameter of the He-Ne laser was 3 cm which was in agreement with the theoretical value. The turbulent spreading diameter of the YAG laser was 10.7 cm which is several times larger than the theoretically estimated value. The cause is yet to be analyzed.

LASER GLITTERING IN THE RELATIVELY STABLE PROPAGATION  
LAYER NEAR THE SEA SURFACE

Le Shixiao

(Chengdu Institute of Telecommunication Engineering)

In the fall and winter of 1979 and summer of 1980, we carried out 4,5,7.8, 10, and 21 kilometer communication propagation experiments using a 10.6 micron quasi-straight beam in the optical paths of Tuan Dao - Huang Dao - Tsingtao, Tsingtao-Dai Gong Dao (some of the experimental points were on the piers and over 95% of the optical path is over water) in the Jiao Zhou Bay at 8,10,16,53, and 70 meters above actual water surface, respectively. It was found that the laser glittering near the water surface had the relatively weak characteristics. However, the glittering at 53 and 70 meter heights did not have the property. This conclusion relieved the doubt that below 40 meters from the water surface is the "restricted area" for laser propagation. It is advantageous for the development of laser communication between islands to reduce the construction cost (the investment is higher for the communication points built on the mountain top or the top of high rise buildings).

The paper also explained this phenomenon from the viewpoints of the water vapor viscosity and the energy exchange between the sea and the water vapor.

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